UNITED STATES DISTRICT COURT
DISTRICT OF MASSACHUSETTS

CIVIL ACTION NO. 20-11887-RGS

LONG HUA TECHNOLOGY CO., LTD

v.

A123 SYSTEMS, LLC

MEMORANDUM AND ORDER ON
CLAIM CONSTRUCTION

September 9, 2021

STEARNS, D.J.

Plaintiff Long Hua Technology Co., Ltd., accuses defendant A123 Systems, LLC, of infringing United States Patent Nos. 7,803,484 (the '484 patent) and 8,034,480 (the '480 patent). Before the court are the parties' briefs on claim construction. The court received tutorial presentations and heard argument pursuant to *Markman v. Westview Instruments, Inc.*, 517 U.S. 370 (1996), on August 31, 2021.

THE '484 AND '480 PATENTS

Both the '484 patent, which issued on September 28, 2010, and the '480 patent, which issued on October 11, 2011,[1] are entitled "High Rate

[1] The '480 patent is a continuation of the '484 patent and includes a terminal disclaimer synchronizing the expiration date to match that of the '484 patent.

Capability Design of Lithium Ion Secondary Battery." The patents list the same inventors, share a specification, and set out nearly identical claims. Accordingly, the court will cite to the '484 patent except in the rare instances in which they differ in some material respect.

The patents are directed to the construction of a lithium ion secondary (rechargeable) battery[2] that uses lithium iron phosphate ($LiFePO_4$) as a major component of the positive electrode. Ordinarily, the use of a material like $LiFePO_4$, which has a low conductivity, would impede the movement of electrons and lithium ions across the battery, causing the battery to have an undesirably low "high rate capability."[3] The claimed invention overcomes this impediment by constructing a positive electrode layer within the battery having an area-to-thickness ratio greater than ¶[6] mm. At this threshold, ionic impedance is reduced and a high rate capability is attainable.

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[2] More fully described, a secondary battery is a storage cell in which cell reactions are reversible, permitting the original chemical conditions within the cell to be restored by passing current flow into it from an external source, hence causing the cell to become "recharged."

[3] High rate capability is a measure of the ability of the battery to quickly charge/discharge without significant loss of battery capacity over time. More technically, the '484 patent defines high rate capability as achieved when "the capacity [of the battery] at the discharge rate of 10C is greater than 80% of the capacity at the discharge rate of 1C." '484 patent, col. 2, ll. 9-11. C rate is the inverse of time, in hours, needed to discharge the useable capacity of a battery, so 10C is the discharge rate in six minutes (1/10 of an hour) and 1C is the discharge rate in one hour.

Claims 1 and 6 of the '484 patent are representative.

1. A lithium ion secondary battery comprising a positive electrode; a negative electrode; a separating film that separates the positive electrode and the negative electrode; and an electrolyte forming a lithium ion channel between the positive electrode and the negative electrode, wherein the positive electrode comprises a current collector substrate; one single tab or a plurality of tabs connected to the current collector substrate; and an electrode layer of a positive electrode material on one surface of the current collector, wherein the positive electrode material comprises $LiFePO_4$ as a major component thereof, and the electrode layer of the positive electrode material has a ratio of its area to its thickness greater than 1.2×10^6 mm, and wherein the lithium ion secondary battery has a ratio of its capacity at discharge rate of 10C to its capacity at discharge rate of 1C is [sic] greater than 80%.

6. A lithium ion secondary battery comprising a positive electrode; a negative electrode; a separating film that separates the positive electrode and the negative electrode; and an electrolyte forming a lithium ion channel between the positive electrode and the negative electrode, wherein the positive electrode comprises a current collector substrate; one single tab or a plurality of tabs connected to the current collector substrate; and an electrode layer of a positive electrode material on one surface of the substrate, wherein the positive electrode material comprises a lithium compound as a major component thereof, the lithium compound has a conductivity of a level between 10^{-5} to 10^{-10} S/cm, and the electrode layer of the positive electrode material has a ratio of its area to its thickness greater than 1.2×10^6 mm, and wherein the lithium ion secondary battery has a ratio of its capacity at discharge rate of 10C to its capacity at discharge rate of 1C greater than 80%.

The parties dispute the following claim terms:

- "the positive electrode material comprises $LiFePO_4$ as a major component thereof"

- "$LiMPO_4$ is LiFePO4, metal-doped $LiFePO_4$, or surface modified or carbon-coated $LiFePO_4$"
- "the positive electrode material comprises a lithium compound as a major component thereof, the lithium compound has a conductivity of a level between 10^{-5} to 10^{-10} S/cm"
- "a ratio of its capacity at discharge rate of 10C to its capacity at discharge rate of 1C is greater than 80%"
- "the electrode layer of the positive electrode material"
- "the electrode layer of the positive electrode material has a ratio of its area to its thickness greater than about 9.31×10^5 mm"
- "two adjacent tabs has a span less than 2400 mm along a longitudinal direction of the substrate"

DISCUSSION

Claim construction is a matter of law. *See Markman*, 517 U.S. at 388-389. Claim terms are generally given the ordinary and customary meaning that would be ascribed by a person of ordinary skill in the art in question at the time of the invention.[4] *Phillips v. AWH Corp.*, 415 F.3d

[4] Long Hua asserts that a person of ordinary skill in the art is "a person having a Doctorate degree, or at least a Bachelor's degree with at least 5 years of experience in chemistry, material science, physics or other technology relevant to functional battery materials, electrode design, and battery cell design." Long Hua's Opening Br. (Dkt # 20) at 4. A123's expert similarly proposes that a person of ordinary skill in the art is "a person having a Doctorate degree in Materials Science, Chemistry, or a similar science or engineering field, or at least a Bachelor's degree with at least 5 years of

1303, 1312-1313 (Fed. Cir. 2005) (en banc). In determining how a person of ordinary skill in the art would have understood the claim terms at the time of the invention, the court looks to the specification of the patent, its prosecution history, and, in limited instances where appropriate, extrinsic evidence such as dictionaries, treatises, or expert testimony. *Id.* at 1315-1317. Ultimately, "[t]he construction that stays true to the claim language and most naturally aligns with the patent's description of the invention will be, in the end, the correct construction." *Id.* at 1316 (citation omitted).

"the positive electrode material comprises $LiFePO_4$ as a major component thereof"

A123 argues that the term "the positive electrode material comprises $LiFePO_4$ as a major component thereof" means "most of the positive electrode material is the compound defined by a chemically ordered lattice including 4.40% Lithium, 35.40% Iron, 19.63% Phosphorus, and 40.57% Oxygen by weight; and excluding nano LiFePO4, metal-doped LiFePO4, surface-modified LiFePO4, and carbon-coated LiFePO4." Long Hua proposes that the court either accept the ordinary and customary meaning of the words or adopt the following definition: "[T]he positive electrode material includes as its active ingredient, in a weight proportion greater than

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experience in lithium ion battery production or chemistry." Li Decl. (Dkt # 24) ¶ 40.

the weight proportion of other ingredients present, a chemical compound composed of atoms in the following relationship, one lithium (Li), one iron (Fe) and one phosphate (PO_4)."

There are two issues to consider in construing this term: (1) the meaning of "$LiFePO_4$" (specifically, whether it encompasses carbon-coated, doped, and/or nano $LiFePO_4$); and (2) the meaning of "major component." As to the first, the court finds Long Hua's proposed construction to be more consistent with the intrinsic record. Not only does the sample experiment disclosed in the patents use carbon-coated $LiFePO_4$ to form the positive electrode (indicating that the claimed invention covers non-pure forms of $LiFePO_4$), *see* '484 patent, col. 7, ll. 19-25, but the specification also describes a prior art reference which achieved high rate capability by doping $LiFePO_4$ "with titanium, zirconium, niobium, aluminum, or magnesium" as "disclos[ing] lithium ion secondary batteries with high rate capability *that use $LiFePO_4$ as the major ingredient in its positive electrode active materials*" (indicating that there is no distinction between doped/carbon-coated $LiFePO_4$ and pure $LiFePO_4$ for the purposes of the claimed invention), *see id.*, col. 1, ll. 61-65 (emphasis added).

It is true that the patents distinguish between pure $LiFePO_4$ and doped and/or carbon-coated $LiFePO_4$ in terms of their conductivity in other

portions of the specification. But given that the patents are directed to high rate capability (not conductivity[5]), and that even doped and/or carbon-coated $LiFePO_4$ with improved conductivity suffers from the same general infirmity as pure $LiFePO_4$ by this measure, *see id.*, col. 1, ll. 54-57 ("Although the conductivity of $LiFePO_4$ can be raised to between 10^{-2} and 10^{-3} S/cm after the carbon coating treatment, its high rate capability remains low for other reasons yet to be clarified."), the distinction has little relevance for claim construction purposes.

Claim 9 provides some support for A123's position. It distinguishes "$LiFePO_4$" from doped or modified $LiFePO_4$. Presumably, if a reference to $LiFePO_4$ inherently includes doped or modified $LiFePO_4$, there would be no reason for the claim to separately list these compounds in a dependent claim. And because courts generally presume "that the same terms appearing in different portions of the claims should be given the same meaning," *Paragon Sols., LLC v. Timex Corp.*, 566 F.3d 1075, 1087 (Fed. Cir. 2009), quoting *PODS, Inc. v. Porta Stor, Inc.*, 484 F.3d 1359, 1366 (Fed. Cir. 2007), the use

[5] Claim 6 does in one instance refer to conductivity (it specifies that the positive electrode should comprise a lithium compound with conductivity between 10^{-5} and 10^{-10} S/cm), but the invention itself is directed to high rate capability, not conductivity.

of $LiFePO_4$ to refer to something distinct from carbon-coated or doped $LiFePO_4$ in claim 9 arguably should carry forward to its use in claim 1.

On balance, however, the court will not limit the construction of $LiFePO_4$ as A123 advocates. As discussed above, the claims and specification, taken as a whole, indicate that $LiFePO_4$ includes carbon-coated, doped, and nano $LiFePO_4$, and this is enough to overcome the presumption of shared meaning. *See id.* (noting that the presumption of applying the same meaning to the same terms does not apply if "it is clear from the specification and prosecution history that the terms have different meanings at different portions of the claims"), quoting *PODS, Inc.*, 484 F.3d at 1366. The court accordingly adopts Long Hua's definition of $LiFePO_4$ as "a chemical compound composed of atoms in the following relationship, one lithium (Li), one iron (Fe) and one phosphate (PO_4)."[6]

Turning to the phrase "a major component," consistent with the substance of the parties' arguments (if not the specific terminology they propose in their definitions), the court determines that it requires more than

[6] The scope of the term may nevertheless be cabined by the requirement that the compound have "atoms in the following relationship, one lithium (Li), one iron (Fe), and one phosphate (PO_4)." As A123 notes, doping may alter the relationship in a way that the compound will no longer conform to Long Hua's proposed definition.

50% of the positive electrode material to be composed of $LiFePO_4$. *See* Long Hua's Opening Br. at 9 (proposing that "a major component" means "more than 50% of the positive electrode material"); A123's Opening Br. (Dkt # 23) at 16 (proposing that "a major component" means "most," i.e., more than 50%); *see also* '484 patent, col. 2, ll. 6-8 (using "main" as a synonym of "major"); *cf. Fractus, S.A. v. ZTE Corp.*, 2018 WL 4282783, at *7-8 (E.D. Tex. 2018) (construing the related term "majority" to mean "more than 50%"). Thus, "the positive electrode material comprises $LiFePO_4$ as a major component thereof" accordingly means "most (i.e., more than 50%) of the positive electrode material comprises a chemical compound composed of atoms in the following relationship, one lithium (Li), one iron (Fe), and one phosphate (PO_4)."

"$LiMPO_4$ is LiFePO4, metal-doped $LiFePO_4$, or surface modified or carbon-coated $LiFePO_4$"

The parties' arguments regarding this term mirror their arguments for the term "the positive electrode material comprises LiFePO4 as a major component thereof." For the reasons discussed above, the court will carry forward its definition of $LiFePO_4$ as "a chemical compound composed of atoms in the following relationship, one lithium (Li), one iron (Fe), and one phosphate (PO_4)" to this claim term as well.

"the positive electrode material comprises a lithium compound as a major component thereof, the lithium compound has a conductivity of a level between 10^{-5} to 10^{-10} S/cm"

A123 argues that the word "conductivity" as used in this term is indefinite. It contends that, because the specification discusses the concepts of both "electronic conductivity" and "ionic conductivity," '484 patent, col. 4, ll. 29, 38, and because claim 6 does not specify which of the alternatives to use, a skilled artisan would not understand how to measure the conductivity.[7] The court does not agree.

It is clear from context that conductivity refers to the electrical conductivity of the claimed lithium compound, i.e., the inherent ability of that compound to conduct an electrical current. This is a broad measure which reflects electronic conductivity (the movement of electrons) *and* ionic conductivity (the movement of ions). *See id.*, col. 4, ll. 16-18 (noting that electrical impedance may be caused by electronic impedance or ionic impedance); *see also id.*, col. 1, ll. 22-27 (noting that, "[a]s a result" of the low conductivity of LiFePO4, "lithium ions are impeded while entering or leaving" positive electrodes comprised of this material, "causing it to perform

[7] Although A123 briefs this term as if the conductivity of the positive electrode is being measured, a review of the claim language itself reveals that the focus instead is on the conductivity of the *lithium compound* used within that positive electrode.

comparatively worse than LiMn2O4 or LiCoO2"). There thus is no need for the patent to separately specify which alternative to use – both properties are relevant to measuring overarching conductivity.

To the extent that A123 alternatively argues that the calculation of the electrical conductivity of a compound is subject to variation, the specification lists exemplary conductivities for certain compounds that a skilled artisan could use as a reference point. $LiFePO_4$, for example, is noted to have a "conductivity" of 10^{-9} S/cm, whereas $LiMn_2O_4$ and $LiCoO_2$ have a conductivity of 10^{-3}~10^{-4} S/cm.

"a ratio of its capacity at discharge rate of 10C to its capacity at discharge rate of 1C is greater than 80%"

A123 contends that this term refers to "a lithium ion secondary battery property brought about by 'the electrode layer of the positive electrode material has a ratio of its area to its thickness greater than 1.2×10^6 mm.'" Long Hua proposes that the court adopt the plain and ordinary meaning of the terms or, alternatively, the definition: "[A] ratio of its capacity at discharge rate of 10C to its capacity at discharge rate of 1C is greater than 80% wherein the capacities are measured of the same battery without other differences in conditions, such as temperature differences and significant time separation, that would affect capacities measured."

As the lumbering semantics of the proposed definitions illustrates, the court agrees with Long Hua that the term is best left to its plain and ordinary meaning. In so choosing, the court rejects A123's argument that the term must be understood in terms of the claimed 1.2×10^6 mm area-to-thickness ratio in the electrode layer. Although the intrinsic record links the discharge ratio to the area-to-thickness ratio[8] and the specification ties the emergence of the property (known as high rate capability) to the recited 1.2×10^6 mm area-to-thickness ratio,[9] the property itself has a meaning independent of the claimed ratio.[10] A battery can have "a ratio of its capacity at discharge rate of 10C to its capacity at discharge rate of 1C is greater than 80%" without having an area-to-thickness ratio within the electrode layer of 1.2×10^6 mm (although perhaps with an electrode layer comprised of a different compound). The court, on the other hand, expresses no opinion on the

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[8] *See* Ex. 6 to A123's Opening Br. (Dkt # 23-6) at 6 (describing "a ratio of its capacity at discharge rate of 10C to its capacity at discharge rate of 1C is greater than 80%" as a property "brought about" by the 1.2×10^6 mm area-to-thickness ratio).

[9] *See* '484 patent, col. 2, ll. 8-20, 23-33 (describing the claimed area-to-thickness ratio as "allow[ing]" the battery to have or "produc[ing]" a battery with "a ratio of its capacity at discharge rate of 10C to its capacity at discharge rate of 1C is greater than 80%").

[10] As Long Hua notes, "a ratio of its capacity at discharge rate of 10C to its capacity at discharge rate of 1C is greater than 80%" arguably describes the battery as a whole, whereas the 1.2×10^6 mm area-to-thickness ratio is a property ascribed only to the positive electrode.

ability to achieve high rate capability with an $LiFePO_4$-based electrode layer without the recited area-to-thickness ratio.

As confirmation of its understanding, the court notes that the specification treats "a ratio of its capacity at discharge rate of 10C to its capacity at discharge rate of 1C is greater than 80%" as a property distinct from the 1.2×10^6 mm area-to-thickness ratio. For example, the specification lists as two separate preferred embodiments a battery with a 1.2×10^6 mm area-to-thickness ratio and a battery with a 1.2×10^6 mm area-to-thickness ratio "wherein the lithium ion secondary battery has a ratio between its capacity at discharge rate of 10C and its capacity at discharge rate of 1C is greater than 80%," indicating that the latter is a further limitation on the former. *See id.*, col. 3, ll. 1-4; *id.*, col. 3, ll. 48-51.

The patent examiner also appears to have viewed "a ratio of its capacity at discharge rate of 10C to its capacity at discharge rate of 1C is greater than 80%" and the 1.2×10^6 mm area-to-thickness ratio as separate limitations. *See* Ex. 8 to A123's Opening Br. (Dkt. # 23-8) at 2 ("The prior art fail[s] to teach or suggest a lithium ion secondary battery . . . that has [an electrode layer with] a ratio[] of its area to its thickness greater than 1.2×10^6mm *and* wherein the lithium ion secondary battery has a ratio between its capacity at discharge rate of 10C and its capacity at discharge rate of 1C is [sic] greater

than 80%.") (emphasis added); *see also* Ex. 6 to A123's Opening Br. at 2 (amending the claims to add the limitation "a ratio of its capacity at discharge rate of 10C to its capacity at discharge rate of 1C is greater than 80%" in response to the examiner's rejection).

"the electrode layer of the positive electrode material"

Long Hua proposes construing "the electrode layer of the positive electrode material" to mean "an electrode layer defined by positive electrode material comprising [LiFePO4]/[a lithium compound] as a major component thereof that is laid on one surface of a current collector substrate and the electrode layer of the positive electrode material has a ratio of its area to its thickness greater than 1.2×10^6 mm."[11] For its part, A123 proposes the definition: "[T]he single coating layer on one surface of one current collector substrate."[12]

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[11] Long Hua initially proposed as a definition: "[T]he recited electrode layer composed of the recited positive electrode material which is coated on at least one surface of the at least one current collector substrate." It revised this proposed construction in its responsive briefing, however, and A123 does not appear to challenge the reformulation.

[12] In its Response to A123's Opening Brief, Long Hua appears to argue that, even if "the electrode layer of the positive electrode material" is limited to the coating on "one" side of "one" current collector by the prior clause "an electrode layer . . . on one surface of the current collector," the term would nonetheless encompass a coating on the "same" side of several current collectors connected electrically into "one" larger current collector. The court need not reach this issue, however, because regardless of the answer,

The court adopts Long Hua's proposed construction. The patent claims a battery with a positive electrode comprised of, *inter alia*, "a" current collector substrate and "an" electrode layer on one surface of "the" current collector substrate. '484 patent, col. 8, ll. 64, 66; *accord id.*, col. 2, ll. 45, 47. As the Federal Circuit has repeatedly stated, use of the words "a" or "an" in a patent claim generally "carr[ies] the meaning of 'one or more.'"[13] *01 Communique Lab'y, Inc. v. LogMeIn, Inc.*, 687 F.3d 1292, 1297 (Fed. Cir. 2012) (citation omitted). Thus, the patent contemplates a lithium battery that uses more than one current collector substrate and has an electrode layer on one surface of at least one of those current collector substrates.

"the electrode layer of the positive electrode material has a ratio of its area to its thickness greater than about 9.31×10^5 mm"

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its construction of the term "the electrode layer of the positive electrode material" reaches current collectors set up in parallel.

[13] This principle is subject to a limited exception "where the language of the claims themselves, the specification, or the prosecution history necessitate a departure from the rule." *Id.*, quoting *Baldwin Graphic Sys., Inc. v. Siebert, Inc.*, 512 F.3d 1338, 1342-1343 (Fed. Cir. 2008). A123, however, does not offer the court any persuasive reason to depart from the general rule here. At best, it notes that the inventors measured layer thickness by the thickness of the coating on only one side of a current collector substrate, even where two sides were coated, in the sample experiment included in the specification and when distinguishing a prior art reference before the PTO. But this evidence, derived from combining table information with experimental details in the specification, is not sufficiently "clear" to evince an "intent to limit 'a' or 'an' to 'one.'" *01 Communique Lab'y, Inc.*, 687 F.3d at 1297, quoting *Baldwin Graphic Sys., Inc.*, 512 F.3d at 1342.

The court agrees with A123 that this term, which is used only in claim 1 of the '480 patent, must be read consistently with "the electrode layer of the positive electrode material." *See* A123's Opening Br. at 12. Accordingly, the term means that "an electrode layer defined by positive electrode material comprising [$LiFePO_4$]/[a lithium compound] as a major component thereof that is laid on one surface of a current collector substrate and the electrode layer of the positive electrode material has a ratio of its area to its thickness greater than about 9.31×10^5 mm."

To the extent that A123 asks the court to reinterpret the limitation 9.31×10^5 mm to be 1.2×10^6 mm, it declines to do so given the plain language of the claim. And while it may be the case that this limitation is not enabled,[14] the court will reserve that issue for a later juncture.

"two adjacent tabs has a span less than 2400 mm along a longitudinal direction of the substrate"

Long Hua argues that the term means "two adjacent tabs along a longitudinal direction of the recited current collector substrate [that have] a distance between them along that direction of less than 2400 mm."[15] A123

[14] The 9.31×10^5 mm area-to-thickness ratio is only disclosed by the line within Tables 2 and 3 reporting the Group 6 experimental results. The specification does not otherwise mention it.

[15] Long Hua initially proposed the definition "two tabs on a single substrate having a distance between them along the largest dimension of the single substrate of less than 2400 mm." It revised this construction in its

proposes that the court adopt the definition "two tabs on a single substrate having a distance between them along the largest dimension of the single substrate of less than 2400 mm."

At bottom, the parties' dispute centers on whether the adjacent tabs must be on a single, continuous current collector or whether they can be on parallel current collectors connected electrically as "one" larger current collector. For the reasons discussed above, the court finds the intrinsic record to be more consistent with the latter interpretation than the former one. The invention discloses a lithium battery with "a" current collector substrate and "one single or a plurality of tabs" on "the" substrate. *See* '484 patent, col. 8, ll. 64-66. Use of the word "a" implies that the invention may have more than one current collector substrate with tabs along it. The court accordingly adopts Long Hua's construction.

ORDER

The claim terms at issue will be construed for the jury and for all other purposes in the pending litigation in a manner consistent with the above rulings of the court.

SO ORDERED.

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responsive briefing, however, and A123 does not appear to challenge the rewording.

/s/ Richard G. Stearns
UNITED STATES DISTRICT JUDGE